



## NOAA SCIENTIFIC PUBLICATIONS REPORT

DECEMBER 5, 2016

### **HIGHLIGHTED ARTICLES**

#### [Global Carbon Budget 2016](#)

Earth System Science Data (8.286)

#### [The global warming hiatus: Slowdown or redistribution?](#)

Earth's Future (5.62)

#### [Enhanced macroboring and depressed calcification drive net dissolution at high-CO<sub>2</sub> coral reefs](#)

Proceedings of the Royal Society (5.36)

#### [Applying a bioeconomic model to recreational fisheries management: Groundfish in the northeast United States](#)

Marine Resource Economics (2.071)

#### [Ontogenetic shifts in diet and habitat of juvenile green sea turtles in the northwestern Gulf of Mexico](#)

Marine Ecology Progress Series (2.361)

### **CROSS LINE OFFICE ARTICLES**

#### [Comparison of reef fish survey data gathered by open and closed circuit SCUBA divers reveals differences in areas with higher fishing pressure](#)

PLoS ONE (3.234)

#### [Net primary productivity estimates and environmental variables in the Arctic Ocean: An assessment of coupled physical-biogeochemical models](#)

Journal of Geophysical Research - Oceans (3.318)



## NOAA SCIENTIFIC PUBLICATIONS REPORT

DECEMBER 5, 2016

### ADDITIONAL ARTICLES

#### NMFS Publications

#### [Density-dependent growth in Atlantic menhaden: Impacts on current management](#)

North American Journal of Fisheries Management (1.013)

#### [Genetic population structure of a coastal marine fish \(sheepshead \*Archosargus probatocephalus\* \[Sparidae\]\) in the southeastern United States: multiple population clusters based on species-specific microsatellite markers](#)

Bulletin of Marine Science (1.503)

#### [Long-term spatial and temporal patterns of sea turtle strandings in southern Brazil](#)

Marine biology (2.375)

#### OAR Publications

#### [Diagnostic sea ice predictability in the pan-Arctic and U.S. Arctic regional seas](#)

Geophysical Research Letters (4.456)

#### [A unified high-resolution wind and solar dataset from a rapidly updating numerical weather prediction model](#)

Renewable Energy (ScienceDirect - Elsevier)

#### [Deep and abyssal ocean warming from 35 years of repeat hydrography](#)

Geophysical Research Letters (4.456)

#### [Age, growth and natural mortality of blackfin snapper, \*Lutjanus buccanella\*, from the southeastern United States and U. S. Caribbean](#)

Gulf and Caribbean Research (N/A)



## NOAA SCIENTIFIC PUBLICATIONS REPORT

DECEMBER 5, 2016

### [The magnitude of the snow-sourced reactive nitrogen flux to the boundary layer in the Uintah Basin, Utah, USA](#)

Atmospheric Chemistry and Physics (5.114)

### [Comparison of global precipitation estimates across a range of temporal and spatial scales](#)

Journal of Climate (4.31)

### [Feeding ecology of the walleye \(\*Percidae\*, \*Sander vitreus\*\), a resurgent piscivore in Lake Huron \(Laurentian Great Lakes\) after shifts in the prey community](#)

Ecology of Freshwater Fish (2.052)

#### NESDIS Publications

### [Improving simulation of a well-mixed warm water column in the central Bohai Sea in summer with high frequency atmospheric forcing](#)

Journal of Ocean University of China (0.509)

## **OTHER REPORTS, BOOK CHAPTERS, AND INTERNAL PUBLICATIONS**

#### NMFS Publications

### [The economic contribution of marine angler expenditures on durable goods in the United States, 2014](#)

NOAA Technical Memorandum

#### OAR Publications

### [A risk assessment of potential Great Lakes aquatic invaders](#)

NOAA Technical Memorandum



## NOAA SCIENTIFIC PUBLICATIONS REPORT

DECEMBER 5, 2016

### HIGHLIGHTED ARTICLES

#### *Global Carbon Budget 2016*

Earth System Science Data (8.286)

C. Le Quéré, R. M. Andrew, J. G. Canadell, S. Sitch, J. I. Korsbakken, G. P. Peters, A. C. Manning, T. A. Boden, **P. P. Tans (OAR/ESRL)**, R. A. Houghton, R. F. Keeling, **S. Alin (OAR/PMEL)**, O. D. Andrews, P. Anthoni, **L. Barbero (OAR/AOML)**, L. Bopp, F. Chevallier, L. P. Chini, P. Ciais, K. Currie, C. Delire, S. C. Doney, P. Friedlingstein, T. Gkritzalis, I. Harris, J. Hauck, V. Haverd, M. Hoppema, K. Klein Goldewijk, A. K. Jain, E. Kato, A. Körtzinger, P. Landschützer, N. Lefèvre, A. Lenton, S. Lienert, D. Lombardozzi, J. R. Melton, N. Metzl, F. Millero, P. M. S. Monteiro, D. R. Munro, J. E. M. S. Nabel, S. I. Nakaoka, K. O'Brien, A. Olsen, A. M. Omar, T. Ono, **D. Pierrot (OAR/AOML)**, B. Poulter, C. Rödenbeck, J. Salisbury, U. Schuster, J. Schwinger, R. Séférian, I. Skjelvan, B. D. Stocker, **A. J. Sutton (OAR/PMEL)**, T. Takahashi, H. Tian, B. Tilbrook, I. T. van der Laan-Luijkx, G. R. van der Werf, N. Viovy, A. P. Walker, A. Wiltshire, S. Zaehle

- The Global Carbon Budget 2016 is the 11th annual update of emissions of carbon dioxide (CO<sub>2</sub>) and their partitioning among the atmosphere, land, and ocean.
- This data synthesis brings together measurements, statistical information, and analyses of model results in order to provide an assessment of the global carbon budget and their uncertainties for years 1959 to 2015, with a projection for year 2016.

Accurate assessment of anthropogenic carbon dioxide (CO<sub>2</sub>) emissions and their redistribution among the atmosphere, ocean, and terrestrial biosphere – the “global carbon budget” – is important to better understand the global carbon cycle, support the development of climate policies, and project future climate change. Here we describe data sets and methodology to quantify all major components of the global carbon budget, including their uncertainties, based on the combination of a range of data, algorithms, statistics, and model estimates and their interpretation by a



## NOAA SCIENTIFIC PUBLICATIONS REPORT

DECEMBER 5, 2016

broad scientific community. We discuss changes compared to previous estimates and consistency within and among components, alongside methodology and data limitations. CO<sub>2</sub> emissions from fossil fuels and industry ( $E_{FF}$ ) are based on energy statistics and cement production data, respectively, while emissions from land-use change ( $E_{LUC}$ ), mainly deforestation, are based on combined evidence from land-cover change data, fire activity associated with deforestation, and models. The global atmospheric CO<sub>2</sub> concentration is measured directly and its rate of growth ( $G_{ATM}$ ) is computed from the annual changes in concentration. The mean ocean CO<sub>2</sub> sink ( $S_{OCEAN}$ ) is based on observations from the 1990s, while the annual anomalies and trends are estimated with ocean models. The variability in  $S_{OCEAN}$  is evaluated with data products based on surveys of ocean CO<sub>2</sub> measurements. The global residual terrestrial CO<sub>2</sub> sink ( $S_{LAND}$ ) is estimated by the difference of the other terms of the global carbon budget and compared to results of independent dynamic global vegetation models. We compare the mean land and ocean fluxes and their variability to estimates from three atmospheric inverse methods for three broad latitude bands. All uncertainties are reported as  $\pm 1\sigma$ , reflecting the current capacity to characterize the annual estimates of each component of the global carbon budget. For the last decade available (2006–2015),  $E_{FF}$  was  $9.3 \pm 0.5 \text{ GtC yr}^{-1}$ ,  $E_{LUC}$   $1.0 \pm 0.5 \text{ GtC yr}^{-1}$ ,  $G_{ATM}$   $4.5 \pm 0.1 \text{ GtC yr}^{-1}$ ,  $S_{OCEAN}$   $2.6 \pm 0.5 \text{ GtC yr}^{-1}$ , and  $S_{LAND}$   $3.1 \pm 0.9 \text{ GtC yr}^{-1}$ . For year 2015 alone, the growth in  $E_{FF}$  was approximately zero and emissions remained at  $9.9 \pm 0.5 \text{ GtC yr}^{-1}$ , showing a slowdown in growth of these emissions compared to the average growth of  $1.8 \text{ \% yr}^{-1}$  that took place during 2006–2015. Also, for 2015,  $E_{LUC}$  was  $1.3 \pm 0.5 \text{ GtC yr}^{-1}$ ,  $G_{ATM}$  was  $6.3 \pm 0.2 \text{ GtC yr}^{-1}$ ,  $S_{OCEAN}$  was  $3.0 \pm 0.5 \text{ GtC yr}^{-1}$ , and  $S_{LAND}$  was  $1.9 \pm 0.9 \text{ GtC yr}^{-1}$ .  $G_{ATM}$  was higher in 2015 compared to the past decade (2006–2015), reflecting a smaller  $S_{LAND}$  for that year. The global atmospheric CO<sub>2</sub> concentration reached  $399.4 \pm 0.1 \text{ ppm}$  averaged over 2015. For 2016, preliminary data indicate the continuation of low growth in  $E_{FF}$  with  $+0.2 \text{ \%}$  (range of  $-1.0$  to  $+1.8 \text{ \%}$ ) based on national emissions projections for China and USA, and projections of gross domestic product corrected for recent changes in the carbon intensity of the economy for the rest of the world. In spite of the low



## NOAA SCIENTIFIC PUBLICATIONS REPORT

DECEMBER 5, 2016

growth of  $E_{FF}$  in 2016, the growth rate in atmospheric  $CO_2$  concentration is expected to be relatively high because of the persistence of the smaller residual terrestrial sink ( $S_{LAND}$ ) in response to El Niño conditions of 2015–2016. From this projection of  $E_{FF}$  and assumed constant  $E_{LUC}$  for 2016, cumulative emissions of  $CO_2$  will reach  $565 \pm 55$  GtC ( $2075 \pm 205$  Gt $CO_2$ ) for 1870–2016, about 75 % from  $E_{FF}$  and 25 % from  $E_{LUC}$ . This living data update documents changes in the methods and data sets used in this new carbon budget compared with previous publications of this data set (Le Quéré et al., 2015b, a, 2014, 2013). All observations presented here can be downloaded from the Carbon Dioxide Information Analysis Center (doi:10.3334/CDIAC/GCP\_2016).

Publication date: November 14, 2016

Available online: <http://www.earth-syst-sci-data.net/8/605/2016/essd-8-605-2016.html>

### *The global warming hiatus: Slowdown or redistribution?*

Earth's Future (5.62)

X. H. Yan, **T. Boyer (NESDIS/NCEI)**, K. Trenberth, T. R. Karl, S. P. Xie, K. K. Tung, D. Roemmich

- From 1998 to 2013, the rate of global mean surface warming slowed (some have termed this a global warming hiatus); the authors argue that this represents a redistribution of energy within the Earth system.
- Natural, decadal variability plays a crucial role in the rate of global surface warming.
- Improved understanding of ocean distribution and redistribution of heat will help us better monitor Earth energy budget and will maintain and increase ocean monitoring.

Global mean surface temperatures (GMST) exhibited a smaller rate of warming during 1998–2013, compared to the warming in the latter half of the 20th Century. Although, not a “true” hiatus in the strict definition of the word, this has been termed the “global warming hiatus” by IPCC (2013). There have been other periods that have also been defined as the “hiatus” depending on the analysis.



## NOAA SCIENTIFIC PUBLICATIONS REPORT

DECEMBER 5, 2016

There are a number of uncertainties and knowledge gaps regarding the “hiatus.” This report reviews these issues and also posits insights from a collective set of diverse information that helps us understand what we do and do not know. One salient insight is that the GMST phenomenon is a surface characteristic that does not represent a slowdown in warming of the climate system but rather is an energy redistribution within the oceans. Improved understanding of the ocean distribution and redistribution of heat will help better monitor Earth's energy budget and its consequences. A review of recent scientific publications on the “hiatus” shows the difficulty and complexities in pinpointing the oceanic sink of the “missing heat” from the atmosphere and the upper layer of the oceans, which defines the “hiatus.” Advances in “hiatus” research and outlooks (recommendations) are given in this report.

Publication date: November 22, 2016

Available online:

<http://onlinelibrary.wiley.com/doi/10.1002/2016EF000417/abstract>

*Enhanced macroboring and depressed calcification drive net dissolution at high-CO<sub>2</sub> coral reefs*

Proceedings of the Royal Society (5.36)

**I. C. Enochs, D. P. Manzello, G. Kolodziej, S. H. C. Noonan, L. Valentino, K. E. Fabricius (OAR/AOML)**

- This is the first comprehensive experimental study of bioerosion and calcification from a naturally high-CO<sub>2</sub> reef ecosystem.
- Ocean acidification conditions were correlated with decreased calcification and increased macroboring, primarily by annelids.

Ocean acidification (OA) impacts the physiology of diverse marine taxa; among them corals that create complex reef framework structures. Biological processes operating on coral reef frameworks remain largely unknown from naturally high-carbon-dioxide (CO<sub>2</sub>) ecosystems. For the first time, we independently quantified the response of multiple functional groups instrumental in the construction and erosion of these frameworks (accretion, macroboring, microboring, and grazing)



## NOAA SCIENTIFIC PUBLICATIONS REPORT

DECEMBER 5, 2016

along natural OA gradients. We deployed blocks of dead coral skeleton for roughly 2 years at two reefs in Papua New Guinea, each experiencing volcanically enriched CO<sub>2</sub>, and employed high-resolution micro-computed tomography (micro-CT) to create three-dimensional models of changing skeletal structure. OA conditions were correlated with decreased calcification and increased macroboring, primarily by annelids, representing a group of bioeroders not previously known to respond to OA. Incubation of these blocks, using the alkalinity anomaly methodology, revealed a switch from net calcification to net dissolution at a pH of roughly 7.8, within Intergovernmental Panel on Climate Change's (IPCC) predictions for global ocean waters by the end of the century. Together these data represent the first comprehensive experimental study of bioerosion and calcification from a naturally high-CO<sub>2</sub> reef ecosystem, where the processes of accelerated erosion and depressed calcification have combined to alter the permanence of this essential framework habitat.

Online: <http://rspb.royalsocietypublishing.org/content/283/1842/20161742>

Applying a bioeconomic model to recreational fisheries management: Groundfish in the northeast United States

Marine Resource Economics (2.071)

**M. Y. Lee (NMFS/NEFSC), S. Steinback (NMFS/NEFSC), K. Wallmo (NMFS/OST)**

- Angler behavior should be built into recreational fisheries management.
- The recreational policies for NE groundfish in 2014 were not cost effective and sensitive to increased discard mortality.

Recreational fisheries regulations frequently consist of possession limits, size limits, and seasonal closures that constrain the ability of recreational fishermen to catch or land fish. It is difficult to predict how these regulations will influence angler participation and recreational fishing mortality. This research integrates a utility-theory consistent model of demand for recreational fishing trips with an age-structured stock dynamics model to provide policy relevant advice to managers of the groundfish fishery in the Northeast United States. The recreational cod and



## NOAA SCIENTIFIC PUBLICATIONS REPORT

DECEMBER 5, 2016

haddock regulations implemented in 2014 have high costs in terms of foregone angler welfare and minimal positive impacts on stock conditions after three years. The ability of policies that generate large amounts of discarding, like high minimum size limits, to meet conservation objectives are also found to be quite sensitive to assumptions about the recreational discard mortality rate.

Accepted: October 28, 2016

### *Ontogenetic shifts in diet and habitat of juvenile green sea turtles in the northwestern Gulf of Mexico*

Marine Ecology Progress Series (2.361)

Authors: **L. N. Howell** (NMFS/SEFSC), K. J. Reich, D. J. Shaver, A. M. Landry, Jr, C. C. Gorga

- The dual approach of stable isotope analysis and stomach content analysis offered insight on the dietary and habitat shifts of juvenile *C. mydas* in Texas waters throughout different phases in the species life history.
- The results of this study on foraging dynamics can be used to enhance regulations and protection measures for green turtles at all life history stages, hence strengthening programs aimed at protecting this threatened species and habitats on which it depends.

Effective management of a rapidly increasing juvenile green sea turtle (*Chelonia mydas*) population necessitates an understanding of the foraging grounds utilized throughout ontogeny. Research reported herein utilized stomach content (SCA) and stable isotope analyses (SIA) of multiple size classes of green turtles foraging along the middle (MTC) and lower Texas coasts (LTC) in the Northwestern Gulf of Mexico to identify ontogenetic shifts in foraging behavior. Spatial differences of diet and habitat residency were examined based on samples gathered from live ( $n = 55$ ) and deceased turtles ( $n = 114$ ). Additionally, the isotopic composition of putative forage material within nearshore and inshore habitats was investigated to determine prey contribution to diet. Green turtle recruitment to neritic channel environments in Texas waters at sizes  $<25$  cm straight carapace length (SCL) was established based on the presence of benthic macroalgae in the diet. Integration of



## NOAA SCIENTIFIC PUBLICATIONS REPORT

DECEMBER 5, 2016

SCA with SIA of carbon and nitrogen in scute material, as well as potential prey, revealed a subsequent inshore shift to seagrass beds before obtaining 35 cm SCL for turtles of the LTC, while turtles from the MTC exhibited considerable variation in size at transition. This study improves the understanding of the feeding ecology of green turtles within critical foraging grounds of the Texas coast.

Publication date: November 9, 2016

Available online: <http://www.int-res.com/articles/meps2016/559/m559p217.pdf>

### CROSS LINE OFFICE ARTICLES

*Comparison of reef fish survey data gathered by open and closed circuit SCUBA divers reveals differences in areas with higher fishing pressure*

PLoS ONE (3.234)

**A. E. Gray (NMFS/PIFSC), I. D. Williams (NMFS/PIFSC), K. A. Stamoulis, R. C. Boland (NMFS/PIFSC), K. C. Lino (NMFS/PIFSC), B. Hauk (NOS/Papahānaumokuākea Marine National Monument), J. Leonard (NOS/Papahānaumokuākea Marine National Monument), J. Rooney (NMFS/PIFSC), J. Asher (NMFS/PIFSC), K. Lopes Jr., R. K. Kosaki (NOS/Papahānaumokuākea Marine National Monument)**

- There was no significant difference between survey data gathered using open versus closed circuit SCUBA except in areas of high fishing pressure
- Certain targeted fishes may avoid open circuit divers during underwater visual surveys in areas of high spearfishing pressure and lead to an underestimation of biomass

Visual survey by divers using open-circuit (OC) SCUBA is the most widely used approach to survey coral reef fishes. Therefore, it is important to quantify sources of bias in OC surveys, such as the possibility that avoidance of OC divers by fishes can lead to undercounting in areas where targeted species have come to associate divers with a risk of being speared. One potential way to reduce diver avoidance is to utilize closed circuit rebreathers (CCRs), which do not produce the noise and bubbles that are a major source of disturbance associated with OC diving. For this study, we conducted 66 paired OC and CCR fish surveys in the Main Hawaiian



## NOAA SCIENTIFIC PUBLICATIONS REPORT

DECEMBER 5, 2016

Islands at locations with relatively high, moderate, and light fishing pressure. We found no significant differences in biomass estimates between OC and CCR surveys when data were pooled across all sites, however there were differences at the most heavily fished location, Oahu. There, biomass estimates from OC divers were significantly lower for several targeted fish groups, including surgeonfishes, targeted wrasses, and snappers, as well as for all targeted fishes combined, with mean OC biomass between 32 and 68% of mean CCR biomass. There were no clear differences between OC and CCR biomass estimates for these groups at sites with moderate or low fishing pressure, or at any location for other targeted fish groups, including groupers, parrotfishes, and goatfishes. Bias associated with avoidance of OC divers at heavily fished locations could be substantially reduced, or at least calibrated for, by utilization of CCR. In addition to being affected by fishing pressure, the extent to which avoidance of OC divers is problematic for visual surveys varies greatly among taxa, and is likely to be highly influenced by the survey methodology and dimensions used.

Accepted: November 21, 2016

*Net primary productivity estimates and environmental variables in the Arctic Ocean: An assessment of coupled physical-biogeochemical models*

Journal of Geophysical Research - Oceans (3.318)

Y. J. Lee, P. A. Matrai, M. A. M. Friedrichs, **V. S. Saba** (NMFS/NEFSC), O. Aumont, M. Babin, E. T. Buitenhuis, M. Chevallier, L. de Mora, M. Dessert, **J. P. Dunne** (NOAA/OAR/GFDL), I. Ellingsen, D. Feldman, R. Frouin, M. Gehlen, T. Gorgues, T. Ilyina, M. Jin, **J. G. John** (NOAA/OAR/GFDL), J. Lawrence, M. Manizza, C. E. Menkes, C. Perruche, V. Le Fouest, E. Popova, A. Romanou, A. Samuelsen, J. Schwinger, R. Séférian, **C. A. Stock** (NOAA/OAR/GFDL), J. Tjiputra, L. B. Tremblay, K. Ueyoshi, M. Vichi, A. Yool, J. Zhang

- Arctic models underestimated net primary productivity (NPP) but overestimated nitrate, mixed layer depth, and euphotic depth.
- Arctic NPP model skill was greatest in low production regions.



## NOAA SCIENTIFIC PUBLICATIONS REPORT

DECEMBER 5, 2016

- Arctic NPP model skill was constrained by different environmental factors in different Arctic Ocean regions.

The relative skill of 21 regional and global biogeochemical models was assessed in terms of how well the models reproduced observed net primary productivity (NPP) and environmental variables such as nitrate concentration ( $\text{NO}_3$ ), mixed layer depth (MLD), euphotic layer depth ( $Z_{\text{eu}}$ ), and sea ice concentration, by comparing results against a newly updated, quality-controlled *in situ* NPP database for the Arctic Ocean (1959-2011). The models broadly captured the spatial features of integrated NPP (iNPP) on a pan-Arctic scale. Most models underestimated iNPP by varying degrees in spite of overestimating surface  $\text{NO}_3$ , MLD, and  $Z_{\text{eu}}$  throughout the regions. Among the models, iNPP exhibited little difference over sea ice condition (ice-free vs. ice-influenced) and bottom depth (shelf vs. deep ocean). The models performed relatively well for the most recent decade and towards the end of Arctic summer. In the Chukchi and Beaufort Seas, regional model skill of iNPP was best associated with how well sea ice concentration was reproduced. Regionally, iNPP was relatively well simulated in the Beaufort Sea and the central Arctic Basin, where *in situ* NPP is low and nutrients are mostly depleted. Models performed less well at simulating iNPP in the Greenland and Chukchi Seas, despite the higher model skill in MLD and sea ice concentration, respectively. iNPP model skill was constrained by different factors in different Arctic Ocean regions. Our study suggests that better parameterization of biological and ecological microbial rates (phytoplankton growth and zooplankton grazing) are needed for improved Arctic Ocean biogeochemical modeling.

Publication date: November 14, 2016

Available Online: <http://onlinelibrary.wiley.com/doi/10.1002/2016JC011993/pdf>

### **ADDITIONAL ARTICLES**

#### NMFS Publications

*Density-dependent growth in Atlantic menhaden: Impacts on current management*  
North American Journal of Fisheries Management (1.013)

**A. M. Schueller & E. H. Williams (NMFS/SEFSC)**



## NOAA SCIENTIFIC PUBLICATIONS REPORT

DECEMBER 5, 2016

- Incorporating length at age information in menhaden population models could influence the way life-history benchmarks are calculated. Currently, stock status is calculated using static, average values over a long time period.
- Results of this study suggest using non-static values are more in line with the current population dynamics given recruitment. Managers may resist this suggestion, as they often prefer benchmarks stay the same over time.
- This study recommends length at age life history information be included in benchmark calculations, which would have an impact on the recommendations for benchmarks in the broader scientific community and would have an impact on management.

Biological reference points (BRPs) are used to determine stock status and set management regulations. BRPs rely on equilibrium life history data, though conditions are not static and density dependence can play a role. Our objective was to determine the relationship between recruitment strength (i.e., density) and mean length and weight at age for Atlantic Menhaden in order to assess the impacts on BRP calculations used for management. Recruitment was tested for autocorrelation and related to time-varying mean lengths and weights at age. Spawning potential ratio (SPR) and yield per recruit (Y/R) benchmarks were calculated across a range of fishing mortality rates,  $F$ , and recruitment. Recruitment was autocorrelated and negatively related to mean lengths and weights at age. Both SPR and Y/R weren't static under non-equilibrium assumptions about recruitment. To maintain SPR with recruitment increased above equilibrium,  $F$  would decrease; while maintaining Y/R would require increased  $F$  to maintain yield. Tracking recruitment gives managers the ability to track the population and its ability to withstand  $F$  in the short term and to make timely management decisions. Changes in life history information over time should be incorporated into BRP calculations and benchmarks, as opposed to being equilibrium based, in order to ensure sustainability of the population while maximizing harvest.

Accepted: November 5, 2016



## NOAA SCIENTIFIC PUBLICATIONS REPORT

DECEMBER 5, 2016

*Genetic population structure of a coastal marine fish (sheepshead *Archosargus probatocephalus* [Sparidae]) in the southeastern United States: multiple population clusters based on species-specific microsatellite markers*  
Bulletin of Marine Science (1.503)

S. Seyoum, **R. S. McBride** (NMFS/NEFSC), C. Puchutulegui, J. Dutka-Gianelli, A. C. Alvarez, and K. Panzner

- These results will aid development of future fishery management plans (FMPs) for this species, as FMPs exist for only a few states along the southeastern seaboard of the United States, even though the recreational sheepshead fishery is the 10<sup>th</sup> most important in the United States, by landings.
- This study provides strong, coherent evidence of population structure in coastal marine systems, evidence which is still very much needed as scientists explore the connection between theory and practice of population genetics.

Sheepshead, *Archosargus probatocephalus* (Walbaum 1792), have long been separated into three subspecies based on meristic traits, particularly counts of pigmented bars on the side of the body. Here, we evaluate sheepshead genetic variation – both mtDNA and microsatellite – within the domain of the two morphologically-defined subspecies, *A. p. probatocephalus* and *A. p. oviceps*. Sheepshead were collected in coastal habitats of the southeastern United States, from North Carolina (Atlantic Ocean) to Texas (Gulf of Mexico). Significant variations in the mtDNA control region data indicated that the sheepshead is divided into two populations by a genetic break originating somewhere between Apalachicola (Florida gulf coast) and Indian River (Florida Atlantic coast), leaving a wide margin of uncertainty as to the exact area of the division. Use of species-specific microsatellite markers, however, showed that the sheepshead is geographically structured into three population clusters by two genetic breaks. The first genetic break occurred at Apalachee Bay, close to the boundary of the two morphologically-defined subspecies (i.e., between Apalachicola and Steinhatchee, Gulf of Mexico). The second genetic break occurred in south Florida, Atlantic



## NOAA SCIENTIFIC PUBLICATIONS REPORT

DECEMBER 5, 2016

Ocean), where it coincided with a discontinuity of estuarine habitat between Miami and Palm Beach that likely impedes gene flow between populations. This second genetic boundary had been unrecognized for sheepshead, although it has been widely recognized as a genetic boundary for many other nearshore fish species in the southeastern United States.

Acceptance date: November 16, 2016

*Long-term spatial and temporal patterns of sea turtle strandings in southern Brazil*  
Marine biology (2.375)

D. S. Monteiro, S. C. Estima, T. B. R. Gandra, A. P. Silva, L. Bugoni, Y.

**Swimmer (NMFS/PIFSC), J. A. Seminoff (NMFS/SWFSC), E. R. Secchi**

- A 20-year data set is presented on the patterns of live and dead sea turtle strandings along the southern coast of Brazil
- Spatial and temporal stranding patterns suggest mortalities were often a result of interactions with fisheries
- Management recommendations to reduce turtle mortality are made including changes in fishing gear used and closing fishing at times when turtles and fisheries are likely to occur in the same area

Strandings of marine vertebrates along beaches have been widely used to infer threats and causes of mortality in adjacent waters. Understanding the influence of anthropogenic impacts on sea turtle survival is essential for effective conservation, yet limited data are available on the magnitude and patterns of sea turtle mortalities in southern Brazil. Our study reports sea turtle stranding data obtained from monthly beach surveys undertaken from 1995 to 2014 in the state of Rio Grande do Sul, Brazil, and when possible, we identify causes of mortality associated with different fisheries. A total of 6285 turtles of five species were encountered, with the three most common species being loggerhead (*Caretta caretta*;  $n = 3192$ ), green (*Chelonia mydas*;  $n = 2572$ ), and leatherback turtles (*Dermochelys coriacea*;  $n = 376$ ). Generalized linear models demonstrated that loggerhead and green turtle strandings have increased over the last 10 years. Strandings were highest from October to March, which coincides with the greatest bottom pair trawl, gill net, and



## NOAA SCIENTIFIC PUBLICATIONS REPORT

DECEMBER 5, 2016

possibly double-rig trawl fishing effort near the coast. Our results provide a baseline to compare future sea turtle stranding patterns. For reducing sea turtle mortalities, we suggest that time/area closures and/or reduction in gill net, pair trawl, and possibly double-rig trawl fishing effort in coastal waters of southern Brazil during austral spring and summer be considered for future fisheries management plans.

Publication date: November 4, 2016

Available Online: <http://link.springer.com/article/10.1007/s00227-016-3018-4>

### OAR Publications

*Diagnostic sea ice predictability in the pan-Arctic and U.S. Arctic regional seas*  
Geophysical Research Letters (4.456)

**W. Cheng, E. Blanchard-Wrigglesworth, C. M. Bitz, C. Ladd, P. J. Stabeno**  
(OAR/PMEL)

- While qualitatively similar, quantitative differences exist in ice area lagged correlation in models with or without data assimilation.
- Regional predictability is strongly dependent upon location and season.
- Pan-Arctic ice area summer (winter) limb memory intensifies (weakens) as the climate warms, but there are across-region variations.

This study assesses sea ice predictability in the pan-Arctic and U.S. Arctic regional (Bering, Chukchi, and Beaufort) seas with a purpose of understanding regional differences from the pan-Arctic perspective and how predictability might change under changing climate. Lagged correlation is derived using existing output from the Community Earth System Model Large Ensemble (CESM-LE), Pan-Arctic Ice-Ocean Modeling and Assimilation System, and NOAA Coupled Forecast System Reanalysis models. While qualitatively similar, quantitative differences exist in Arctic ice area lagged correlation in models with or without data assimilation. On regional scales, modeled ice area lagged correlations are strongly location and season dependent. A robust feature in the CESM-LE is that the pan-Arctic melt-to-freeze season ice area memory intensifies, whereas the freeze-to-melt season



## NOAA SCIENTIFIC PUBLICATIONS REPORT

DECEMBER 5, 2016

memory weakens as climate warms, but there are across-region variations in the sea ice predictability changes with changing climate.

Publication date: November 17, 2016

Available online:

<http://onlinelibrary.wiley.com/doi/10.1002/2016GL070735/abstract>

*A unified high-resolution wind and solar dataset from a rapidly updating numerical weather prediction model*

Renewable Energy (ScienceDirect - Elsevier)

E. P. James, **S. G. Benjamin, M. Marquis (ESRL/GSD)**

- The dataset presented in this study fills a unique niche in the renewable energy community by providing meteorologically-consistent time-matched estimates of the wind and solar resource across the CONUS.
- This dataset also represents a starting point for further exploration of the relationships between wind and solar energy, and we anticipate the emergence of new applications of the dataset as well.

A new gridded dataset for wind and solar resource estimation over the contiguous United States has been derived from hourly updated 1-h forecasts from the National Oceanic and Atmospheric Administration High-Resolution Rapid Refresh (HRRR) 3-km model composited over a three-year period (approximately 22 000 forecast model runs). The unique dataset features hourly data assimilation, and provides physically consistent wind and solar estimates for the renewable energy industry. The wind resource dataset shows strong similarity to that previously provided by a Department of Energy-funded study, and it includes estimates in southern Canada and northern Mexico. The solar resource dataset represents an initial step towards application-specific fields such as global horizontal and direct normal irradiance. This combined dataset will continue to be augmented with new forecast data from the advanced HRRR atmospheric/land-surface model.

Publication date: October 28, 2016

Available online:

<http://www.sciencedirect.com/science/article/pii/S0960148116309363>



## NOAA SCIENTIFIC PUBLICATIONS REPORT

DECEMBER 5, 2016

### *Deep and abyssal ocean warming from 35 years of repeat hydrography*

Geophysical Research Letters (4.456)

D. G. Desbruyères, S. G. Purkey, E. L. McDonagh, **G. C. Johnson (OAR/PMEL)**,  
B. A. King

- Data from three global surveys of ocean water properties were combined to study deep ocean warming trends.
- Globally, the data show warming in waters below 2000m from 1991 to 2010.
- Warming trends varied regionally and by depth.

Global and regional ocean warming deeper than 2000 m is investigated using 35 years of sustained repeat hydrographic survey data starting in 1981. The global long-term temperature trend below 2000 m, representing the time period 1991–2010, is equivalent to a mean heat flux of  $0.065 \pm 0.040 \text{ W m}^{-2}$  applied over the Earth's surface area. The strongest warming rates are found in the abyssal layer (4000–6000 m), which contributes to one third of the total heat uptake with the largest contribution from the Southern and Pacific Oceans. A similar regional pattern is found in the deep layer (2000–4000 m), which explains the remaining two thirds of the total heat uptake yet with larger uncertainties. The global average warming rate did not change within uncertainties pre-2000 versus post-2000, whereas ocean average warming rates decreased in the Pacific and Indian Oceans and increased in the Atlantic and Southern Oceans.

Publication Date: October 9, 2016

Available online: <http://onlinelibrary.wiley.com/doi/10.1002/2016GL070413/full>

### *Age, growth and natural mortality of blackfin Snapper, *Lutjanus buccanella*, from the southeastern United States and U. S. Caribbean*

Gulf and Caribbean Research

**M. L. Burton (NMFS/SEFSC-Beaufort)**, **J. C. Potts (NMFS/SEFSC-Beaufort)**,  
and D. R. Carr

- This paper is the first published study of life history parameters of blackfin snapper which is a managed species from U. S. waters.



## NOAA SCIENTIFIC PUBLICATIONS REPORT

DECEMBER 5, 2016

We determined ages of Blackfin Snapper (*Lutjanus buccanella* Cuvier 1828;  $n = 622$ ) collected from the southeastern United States coast and U. S. Caribbean from 1979 – 2015 using sectioned sagittal otoliths. Opaque zones were determined to be annular, forming March – July (peaking in April – June). Blackfin Snapper ranged from 1 – 27 yrs and from 180 – 609 mm total length (TL). Body size relationships for Blackfin Snapper were:  $TL = 1.09 FL + 0.81$  ( $n = 203$ ,  $r^2 = 0.99$ );  $FL = 0.91 TL + 3.38$  ( $n = 203$ ,  $r^2 = 0.99$ );  $TL = 1.23 SL + 14.27$  ( $n = 83$ ,  $r^2 = 0.97$ );  $FL = 1.14 SL + 10.84$  ( $n = 83$ ,  $r^2 = 0.99$ );  $W = 7.79 \times 10^{-9} TL^{3.09}$  ( $n = 216$ ); and  $W = 9.54 \times 10^{-9} FL^{3.11}$  ( $n = 228$ ). The von Bertalanffy growth equation was:  $L_t = 540 (1 - e^{-0.22(t + 1.16)})$  ( $n = 622$ ). Point estimate of natural mortality was  $M = 0.16$ , while age-specific estimates of  $M$  ranged from  $0.75 - 0.22 \text{ y}^{-1}$  for ages 1 – 27. This study presents the first findings of life history parameters for Blackfin Snapper from the Atlantic waters off the southeastern United States and U. S. Caribbean.

Acceptance date: November 22, 2016

*The magnitude of the snow-sourced reactive nitrogen flux to the boundary layer in the Uintah Basin, Utah, USA*

Atmospheric Chemistry and Physics (5.114)

M. Zatko, J. Erbland, J. Savarino, L. Geng, L. Easley, A. Schauer, **T. Bates, P. K. Quinn**, B. Light, D. Morison, H. D. Osthoff, S. Lyman, W. Neff, B. Yuan, B. Alexander (**OAR/PMEL**)

- During the winter of 2014, snow-sourced reactive nitrogen fluxes contributed to the reactive nitrogen boundary layer budget.
- The emissions estimate for anthropogenic NO<sub>x</sub> is much higher than what was found here.

Reactive nitrogen ( $N_r = \text{NO}, \text{NO}_2, \text{HONO}$ ) and volatile organic carbon emissions from oil and gas extraction activities play a major role in wintertime ground-level ozone exceedance events of up to 140 ppb in the Uintah Basin in eastern Utah. Such events occur only when the ground is snow covered, due to the impacts of snow on the stability and depth of the boundary layer and ultraviolet actinic flux at the surface. Recycling of reactive nitrogen from the photolysis of snow nitrate has



## NOAA SCIENTIFIC PUBLICATIONS REPORT

DECEMBER 5, 2016

been observed in polar and mid-latitude snow, but snow-sourced reactive nitrogen fluxes in mid-latitude regions have not yet been quantified in the field. Here we present vertical profiles of snow nitrate concentration and nitrogen isotopes ( $\delta^{15}\text{N}$ ) collected during the Uintah Basin Winter Ozone Study 2014 (UBWOS 2014), along with observations of insoluble light-absorbing impurities, radiation equivalent mean ice grain radii, and snow density that determine snow optical properties. We use the snow optical properties and nitrate concentrations to calculate ultraviolet actinic flux in snow and the production of  $\text{Nr}$  from the photolysis of snow nitrate. The observed  $\delta^{15}\text{N}(\text{NO}_3^-)$  is used to constrain modeled fractional loss of snow nitrate in a snow chemistry column model, and thus the source of  $\text{Nr}$  to the overlying boundary layer. Snow-surface  $\delta^{15}\text{N}(\text{NO}_3^-)$  measurements range from  $-5$  to  $10$  ‰ and suggest that the local nitrate burden in the Uintah Basin is dominated by primary emissions from anthropogenic sources, except during fresh snowfall events, where remote  $\text{NO}_x$  sources from beyond the basin are dominant. Modeled daily averaged snow-sourced  $\text{Nr}$  fluxes range from  $5.6$  to  $71 \times 10^7 \text{ molec cm}^{-2} \text{ s}^{-1}$  over the course of the field campaign, with a maximum noontime value of  $3.1 \times 10^9 \text{ molec cm}^{-2} \text{ s}^{-1}$ . The top-down emission estimate of primary, anthropogenic  $\text{NO}_x$  in Uintah and Duchesne counties is at least 300 times higher than the estimated snow  $\text{NO}_x$  emissions presented in this study. Our results suggest that snow-sourced reactive nitrogen fluxes are minor contributors to the  $\text{Nr}$  boundary layer budget in the highly polluted Uintah Basin boundary layer during winter 2014.

Publication date: November 9, 2106

*Comparison of global precipitation estimates across a range of temporal and spatial scales*

Journal of Climate (4.31)

**M. Gehne, T. M. Hamill, G. N. Kiladis, K. E. Trenberth (OAR/ESRL)**

- Precipitation estimates varied widely across spatial and temporal time scales
- This suggests that, for global averages, better constrained precipitation products are needed.



## NOAA SCIENTIFIC PUBLICATIONS REPORT

DECEMBER 5, 2016

Characteristics of precipitation estimates for rate and amount from three global high-resolution precipitation products (HRPPs), four global climate data records (CDRs), and four reanalyses are compared. All datasets considered have at least daily temporal resolution. Estimates of global precipitation differ widely from one product to the next, with some differences likely due to differing goals in producing the estimates. HRPPs are intended to produce the best snapshot of the precipitation estimate locally. CDRs of precipitation emphasize homogeneity over instantaneous accuracy. Precipitation estimates from global reanalyses are dynamically consistent with the large-scale circulation but tend to compare poorly to rain gauge estimates since they are forecast by the reanalysis system and precipitation is not assimilated. Regional differences among the estimates in the means and variances are as large as the means and variances, respectively. Even with similar monthly totals, precipitation rates vary significantly among the estimates. Temporal correlations among datasets are large at annual and daily time scales, suggesting that compensating bias errors at annual and random errors at daily time scales dominate the differences. However, the signal-to-noise ratio at intermediate (monthly) time scales can be large enough to result in high correlations overall. It is shown that differences on annual time scales and continental regions are around  $0.8 \text{ mm day}^{-1}$ , which corresponds to  $23 \text{ W m}^{-2}$ . These wide variations in the estimates, even for global averages, highlight the need for better constrained precipitation products in the future.

Publication date: October 10, 2016

Available online: <http://journals.ametsoc.org/doi/10.1175/JCLI-D-15-0618.1>

*Feeding ecology of the walleye (Percidae, Sander vitreus), a resurgent piscivore in Lake Huron (Laurentian Great Lakes) after shifts in the prey community*

Ecology of Freshwater Fish (2.052)

**S. A. Pothoven (OAR/GLERL), C. P. Madenjian, T. O. Höök**

- This study documents shifts in diets of walleye, a key piscivore in Lake Huron, following its recovery and major ecosystem changes.



## NOAA SCIENTIFIC PUBLICATIONS REPORT

DECEMBER 5, 2016

- The results will lead to better understanding of ecosystem processes and impacts of successful fisheries management programs.

Recovering populations of piscivores can challenge understanding of ecosystem function due to impacts on prey and to potentially altered food webs supporting their production. Stocks of walleye (Percidae, *Sander vitreus*), an apex predator in the Laurentian Great Lakes, crashed in the mid-1900s. Management efforts led to recovery by 2009, but recovery coincided with environmental and fish community changes that also had implications for the feeding ecology of walleye. To evaluate potential changes in feeding ecology for this apex predator, we assessed diets in the main basin of Lake Huron and in Saginaw Bay, a large embayment of Lake Huron, during 2009–2011. Walleye switched their diets differently in the main basin and Saginaw Bay, with non-native round goby (Gobiidae, *Neogobius melanostomus*) and rainbow smelt (Osmeridae, *Osmerus mordax*) more prevalent in diets in the main basin, and invertebrates, yellow perch (Percidae, *Perca flavescens*) and gizzard shad (Clupeidae, *Dorosoma cepedianum*) more prevalent in diets in the bay. Feeding strategy plots indicated that there was a high degree of individual specialisation by walleye in the bay and the main basin. Bioenergetic simulations indicated that walleye in Saginaw Bay need to consume 10%–18% more food than a walleye that spends part or all of the year in the main basin, respectively, in order to achieve the same growth rate. The differences in diets between the bay and main basin highlight the flexibility of this apex predator in the face of environmental changes, but changes in diet can alter energy pathways supporting piscivore production.

Publication date: September 18, 2016

Available online: <http://onlinelibrary.wiley.com/doi/10.1111/eff.12315/abstract>

NESDIS Publications

*Improving simulation of a well-mixed warm water column in the central Bohai Sea in summer with high frequency atmospheric forcing*

Journal of Ocean University of China (0.509)



## NOAA SCIENTIFIC PUBLICATIONS REPORT

DECEMBER 5, 2016

X. Wan, W. Ma, **Z. Wang** (National Centers for Environmental Information/CICS-MD), Y. Liu

- From a series of numerical experiments, we concluded that the enhanced mixing in the central Bohai is caused by high frequency wind forcing, rather than tidal or wave forcing as described in previous studies in summer.
- Our new result hints that using high frequency surface atmospheric forcing might be another way to further improve the performance of oceanic simulation.

The influence of high frequency atmospheric forcing on the formation of a well-mixed summer warm water column in the central Bohai Sea is investigated by comparing model simulations driven by daily surface forcing data with those by monthly forcing data. In the absence of high frequency atmospheric forcing, numerical simulations have failed to reproduce this vertically uniform column of warm water, which has been repeatedly measured in the past 30 years. In contrast, high frequency surface forcing is found to strongly influence the structure and distribution of the well-mixed warm water column, which is in good agreement with observations. Our results show that the high frequency forcing can enhance the vertical mixing over the central bank, intensify the downward heat transports and homogenize the water column to form the Bohai central warm column. In particular, we have presented evidence that high frequency forcing plays a dominant role in the formation of the well-mixed warm water column in summer, even without the effects of tidal and surface wave mixing. Therefore, the present study provides a practical and rational way to further improve the performance of oceanic simulations in the Bohai Sea.

Acceptance date: November 2, 2016

### **OTHER REPORTS, BOOK CHAPTERS, AND INTERNAL PUBLICATIONS**

NMFS Publications



## NOAA SCIENTIFIC PUBLICATIONS REPORT

DECEMBER 5, 2016

### *The economic contribution of marine angler expenditures on durable goods in the United States, 2014*

NOAA Technical Memorandum

**S. J. Lovell (NMFS/OST), J. Hilger (NMFS/SWFSC), S. Steinback (NMFS/NEFSC), C. Hutt (NMFS/OSF)**

- At the national level marine anglers spent \$28 billion on fishing equipment and durable goods (e.g., fishing rods, fishing tackle, and boats).
- Expenditures by recreational anglers generated an estimated \$49.6 billion in total output, added \$29 billion in contribution to gross domestic product, contributed \$18 billion to personal income, and supported more than 358 thousand jobs across the United States.

In 2014, NOAA Fisheries conducted a nationwide survey of anglers about their annual purchases of durable goods used for saltwater recreational fishing. Data on angler expenditures allows NOAA Fisheries to better understand the economic contributions of marine recreational fishing to the nations' economy. The sample frame consisted of licensed anglers in coastal states across the U.S. Anglers were asked about their purchases of durable goods such as rods and reels, boats, vehicles, and second homes used for saltwater fishing in the prior 12 months in the state of licensure. Across all coastal states, a total of 10,809 completed surveys were returned with an overall response rate of 11 percent. Mean expenditures for different durable good categories were estimated for both resident and non-resident fishermen in each state. Total expenditures were calculated and used to estimate total economic contributions by state and for the nation. At the national level marine anglers spent \$28 billion on fishing equipment and durable goods (e.g., fishing rods, fishing tackle, and boats). These expenditures generated an estimated \$49.6 billion in total output, added \$29 billion in contribution to gross domestic product, contributed \$18 billion to personal income, and supported more than 358 thousand jobs across the United States.

Publication date: November 7, 2016

Available online: [http://www.st.nmfs.noaa.gov/Assets/economics/durable-expenditures/documents/TM165\\_Durable\\_Goods\\_2014.pdf](http://www.st.nmfs.noaa.gov/Assets/economics/durable-expenditures/documents/TM165_Durable_Goods_2014.pdf)



## NOAA SCIENTIFIC PUBLICATIONS REPORT

DECEMBER 5, 2016

### OAR Publications

#### *A risk assessment of potential Great Lakes aquatic invaders*

#### NOAA Technical Memorandum

A. Fusaro, E. Baker, W. Conard, A. Davidson, K. Dettloff, J. Li, G. Núñez-Mir, **R. Sturtevant, E. Rutherford (OAR/GLERL)**

- This study identifies the potential for introduction, establishment, and impact of 67 species previously identified through peer-reviewed research as being highly likely to invade the Great Lakes basin.
- Since 2003, and in cooperation with United States Geological Survey NOAA GLERL has tracked nonindigenous aquatic species in the Great Lakes system. Information includes an overview of the species life history, ecology, and invasion history as well as maps of current distribution, comprehensive impact assessment and overview of management options.
- These assessments help to identify species posing the highest risk for introduction, establishment and impact, and allow scientists and environmental managers to better monitor for invasions and make decisions about management options in a rapid response situation.

The unique risk assessment tools developed for the GLANSIS database apply a consistent approach across all taxonomic groups and vectors, and allow for cross-species comparison of the potential impact of these species with the realized impact of already established nonindigenous species. This Tech Memo documents these tools and approaches and examines cross-taxa patterns in risk. The study also identifies a subset of 16 species, which should be considered the highest overall risk (introduction + establishment + impact) to the Great Lakes region. These include 5 plants (*Eichhornia crassipes*, *Pistia stratiotes*, *Hydrilla verticillata*, *Egeria densa*, and *Myriophyllum aquaticum*), 6 fishes (*Hypophthalmichthys nobilis*, *Hypophthalmichthys molitrix*, *Rutilus rutilus*, *Ctenopharyngodon idella*, *Alburnus alburnus*, and *Perccottus glenii*), and 4 invertebrates (*Apocorophium lacustre*, *Fredericella sultana*, *Dikerogammarus villosus*, and *Obesogammarus crassus*). Appendices include all raw information that went into the assessment.



## **NOAA SCIENTIFIC PUBLICATIONS REPORT**

**DECEMBER 5, 2016**

Summaries of the risk assessments for each individual species are available through the GLANSIS web Search function. A separate analysis of the risk assessment method and results will appear in an upcoming issue of *Management of Biological Invasions*.

Publication date: not provided by line office